

### **Section 3. Considerations in the Design of MPAs**

Accomplishing MLPA goals and objectives to improve a statewide network of MPAs requires considering a number of issues, some of which are addressed in the MLPA itself. These are as follows:

- Goals of the Marine Life Protection Program
- MPA networks
- Types of MPAs
- Settling goals and objectives for MPAs
- Geographical regions
- Representative and unique habitats
- Species likely to benefit from MPAs
- Enforcement considerations in setting boundaries
- Information used in the design of MPAs
- Monitoring and evaluation strategies and resources
- Other activities affecting resources of concern

Each of these issues is discussed below.

#### ***Goals of the Marine Life Protection Program***

The foundation for achieving the goals and objectives of the MLPA is a Marine Life Protection Program (Program), which must be adopted by the Commission. The MLPA sets the following goals for the Program [FGC subsection 2853(b)]:

- (1) To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems.
- (2) To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.
- (3) To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbance, and to manage these uses in a manner consistent with protecting biodiversity.
- (4) To protect marine natural heritage, including protection of representative and unique marine life habitats in California waters for their intrinsic value.
- (5) To ensure that California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.
- (6) To ensure that the state's MPAs are designed and managed, to the extent possible, as a network.

The goals, objectives, management, monitoring, and evaluation of an MPA network must be consistent with the MLPA goals and objectives.

The goals of the MLPA go beyond the scope of traditional management of activities affecting living marine resources, which has focused upon maximizing yield from individual species or groups of species. For example, the first goal emphasizes biological diversity and the health of

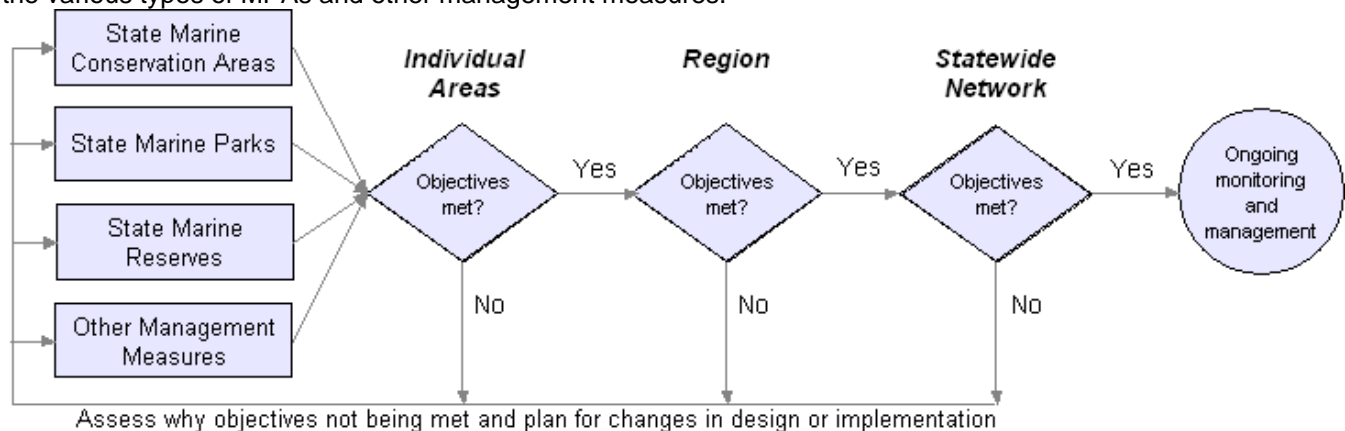
marine ecosystems, rather than the abundance of individual species. The second goal recognizes a role of an MPA system as a tool in fisheries management. The third recognizes the importance of recreation and education in MPAs, and balances these with the protection of biodiversity. The fourth recognizes the value of protecting representative and unique marine habitats for their own value. The fifth and sixth goals address the deficiencies in California's existing MPAs that the MLPA identifies elsewhere in the law. (See the glossary in Appendix J for definitions of some key terms in this goal statement.)

The MLPA also states that the preferred siting alternative for MPA networks, which the Department must present to the Commission, must include an "improved marine life reserve"<sup>4</sup> component" and must be designed according to all of the following guidelines:

- (1) Each MPA shall have identified goals and objectives. Individual MPAs may serve varied primary purposes while collectively achieving the overall goals and guidelines of this chapter.
- (2) Marine Life Reserves in each bioregion shall encompass a representative variety of marine habitat types and communities, across a range of depths and environmental conditions.
- (3) Similar types of marine habitats shall be replicated, to the extent possible, in more than one marine life reserve in each biogeographical region.
- (4) Marine life reserves shall be designed, to the extent practicable, to ensure that activities that upset the natural functions of the area are avoided.
- (5) The MPA network and individual MPAs shall be of adequate size, number, type of protection, and location to ensure that each MPA meets its objectives and that the network as a whole meets the goals and guidelines of the MLPA.

Overall, proposed MPAs in each region must meet their individual goals and objectives, and the collection of MPAs and other management measures in each region and throughout the State must meet the goals and objectives of the MLPA. A simple decision tree for examining this is shown in Figure 3. This diagram indicates how the various types of MPAs along with other management measures work together to meet individual goals, regional goals, and the goals of the MLPA.

Figure 3. Flowchart of the review process to determine if individual, regional, and MLPA goals are being met by the various types of MPAs and other management measures.



<sup>4</sup> As noted previously, marine life reserve in the context of the MLPA is synonymous with a state marine reserve.

## **MPA Networks**

One of the goals of the Marine Life Protection Program calls for improving and managing the state's MPAs as a network, to the extent possible. Although neither statute nor legislative history defines "network," the ordinary dictionary usage contemplates *interconnectedness* as a characteristic of the term. The first finding of the MLPA highlights the fact that California's MPAs "were established on a piecemeal basis rather than according to a coherent plan" [Fish and Game Code Section 2851(a)]. The term "reserve network" has been defined as a group of reserves which is designed to meet objectives that single reserves cannot achieve on their own (Roberts and Hawkins, 2000). In general this definition may infer some direct or indirect connection of MPAs through the dispersal of adult, juvenile, and/or larval organisms or other biological interactions. In most cases, larval and juvenile dispersal rates are not known and oceanography or ocean current patterns may be combined with larval biology to help determine connectivity.

Portions of the overall network will likely differ in each region of the state. The MLPA also requires that the network as a whole meet the various goals and guidelines set forth by the law and contemplates the adaptive management of that network [Fish and Game Code Section 2857(c)(5)]. In order to meet those goals a strict interpretation of an ecological network across the entire state, based on biological connectivity, may not be possible.

As stated above, the MLPA also requires that MPAs be managed as a network, to the extent possible. This implies a coordinated system of MPAs. MPAs might be linked through biological function as in the case of adult and juvenile movement or larval transport. MPAs managed as a network might also be linked by administrative function. The important aspects of this interpretation are that MPAs are linked by common goals and a comprehensive management and monitoring plan, and that they protect areas with a wide variety of representative habitat as required by the MLPA. MPAs should be based on the same guiding principles, design criteria, and processes for implementation. In this case, a statewide network could be one that has connections through design, funding, process, and management. At a minimum, the master plan should insure that the statewide network of MPAs reflects a consistent approach to design, funding and management. The desired outcome would include components of both biological connectivity and administrative function to the extent each are practicable and supported by available science.

Because of the long-term approach of the MLPA Initiative, the statewide network of MPAs called for by the MLPA will be developed in phases, region by region. Within each region, components of the statewide network will be designed consistent with the MLPA and with regional goals and objectives. Each component ultimately will be presented as a series of options, developed in a regional process involving a regional stakeholder group and a sub-group of the science team. Each will include a preferred alternative identified by the Department and delivered to the Commission. Another application of phasing may be an incremental implementation of a portion of the statewide MPA network within a single region. This type of phasing could allow for the completion of baseline surveys or the time necessary to secure additional funding for enforcement and management. Final proposals should include an explanation of the timing of implementation.

## ***Science Advisory Team Guidance on MPA Network Design***

The MLPA calls for the use of the best readily available science, and establishes a science team as one vehicle for fostering consistency with this standard. The MLPA also requires that the MPA network and individual MPAs be of adequate size, number, type of protection, and location as to ensure that each MPA and the network as a whole meet the objectives of the MLPA. In addition, the MLPA requires that representative habitats in each bioregion be replicated to the extent possible in more than one marine reserve.

The availability of scientific information is expected to change and increase over time. As with the rest of this framework, the following guidelines should be modified if new science becomes available that indicates changes are warranted. Additionally, changes should be made based on adaptive management and lessons learned as MPAs are monitored throughout various regions of the state.

The science team provided the following guidance in meeting the MLPA standards. This guidance, which is expressed in ranges for some aspects such as size and spacing of MPAs, should be the starting point for regional discussions of alternative MPAs. Although this guidance is not prescriptive, any significant deviation from it should be consistent with both regional goals and objectives and the requirements of the MLPA. The guidelines are linked to specific objectives and not all guidelines will necessarily be achieved by each MPA. For each recommendation below, detailed references are provided in the bibliography with notation linking them to the appropriate section.

### *Overall MPA and network guidelines:*

- The diversity of species and habitats to be protected, and the diversity of human uses of marine environments, prevents a single optimum network design in all environments.
- For an objective of protecting the diversity of species that live in different habitats and those that move among different habitats over their lifetime, every 'key' marine habitat should be represented in the MPA network.
- For an objective of protecting the diversity of species that live at different depths and to accommodate the ontogenetic movement of individuals to and from nursery or spawning grounds to adult habitats, MPAs should extend from the intertidal zone to deep waters offshore.
- For an objective of protecting adult populations, based on adult neighborhood sizes and movement patterns, MPAs should have an alongshore span of 5-10 km (3-6 m or 2.5-5.4 nm) of coastline, and preferably 10-20 km (6-12.5 m or 5.4-11 nm). Larger MPAs would be required to fully protect marine birds, mammals, and migratory fish.
- For an objective of facilitating dispersal and connectedness of important bottom-dwelling fish and invertebrate groups among MPAs, based on currently known scales of larval dispersal, MPAs should be placed within 50-100 km (31-62 m or 27-54 nm) of each other.
- "Key" marine habitats (defined below) should be replicated in multiple MPAs across large environmental and geographic gradients to protect the greater diversity of species and communities that occur across such gradients, and to protect species from local year-to-year fluctuations in larval production and recruitment.

- For an objective of providing analytical power for management comparisons and to buffer against catastrophic loss of an MPA, at least three to five replicate MPAs should be designed for each habitat type (see pages 43-45) within a biogeographical region.
- For an objective of lessening negative impact while maintaining value, placement of MPAs should take into account local resource use and stakeholder activities.
- Placement of MPAs should take into account the adjacent terrestrial environment and associated human activities.
- For an objective of facilitating adaptive management of the MPA network into the future, and the use of MPAs as natural scientific laboratories, the network design should account for the need to evaluate and monitor biological changes within MPAs.

***1. Different marine habitats support particular species and biological communities, which in themselves vary across large-scale environmental gradients. (See references noted "A" in literature cited)***

MPA networks should include "key" marine habitats (defined below), and each of these habitats should be represented in multiple MPAs across biogeographical regions, upwelling cells, and environmental and geographical gradients.

The strong association of most demersal marine species with particular habitat types (e.g., sea grass beds, submarine canyons, shallow and deep rock reefs), and variation in species composition across latitudinal, depth clines and biogeographical regions, implies that habitat types must be represented across each of these larger environmental gradients to capture the breadth of biodiversity in California's waters.

Different species use marine habitats in different ways. As a result, protection of all the key habitats along the California coast is a critical component of network design. "Key" habitat types provide particular benefits by harboring a different set of species or life stages, having special physical characteristics, or being used in ways that differ from the use of other habitats. For the purpose of evaluation, key habitat types were considered to be; sand beach, rocky intertidal, estuary, shallow sand, deep sand, shallow rock, deep rock, kelp, shallow canyon, and deep canyon. In addition, many species require different habitats at different stages of their life cycle - for example, nearshore species may occur in offshore open ocean habitats during their larval phase. Thus, protection of these habitats, as well as designs that ensure connections between habitats, is critical to MPA success. Individual MPAs that encompass a diversity of habitats will both ensure the protection of species that move among habitats and protect adjoining habitats that benefit one another (e.g., exchange nutrients, productivity). Habitats with unique features (educationally, ecologically, archeologically, anthropologically, culturally, spiritually), or those that are rare should be targeted for inclusion. Habitats that are uniquely productive (e.g. upwelling centers or kelp forests) or aggregative (e.g., fronts) or those that sustain distinct use patterns (e.g. dive training centers, fishing or whale watching hot spots) should also get special consideration in design planning.

***2. Target species are ecologically diverse (See references noted "B" in literature cited)***

MPAs potentially protect a large number of species within their borders, and these species can have dramatically different requirements. As a result, MPA networks cannot be designed for the specific needs of each individual species. Rather, design criteria need to focus on

maximizing collective benefits across species by minimizing compromises where possible. Commonly, it is more practical to consider protecting groups of species based on shared functional characteristics that influence MPA function and design (e.g., patterns of adult movement; patterns of larval dispersal; dependence on critical locations such as spawning grounds, mammal haul out areas, bird rookeries). It is also reasonable to emphasize protection of individual species and groups of species that have special significance because of their dominant role in ecosystems or their economic importance. Ecologically dominant species play the largest roles in the function of coastal ecosystems, and economically important species often experience the greatest impacts from human activities. In addition, knowledge of the distribution of rare, endemic, and endangered species should supplement the use of species groups. Generally, MPAs should not be used solely to enhance single-species management goals.

### **3. *Uses of marine and adjacent terrestrial environments are diverse*** (See references noted "C" in literature cited)

The way people use coastal marine environments is highly diversified in method, goals, timing, economic objectives, and spatial patterns. The wide spectrum of environmental uses should be a part of decisions comparing alternative networks of MPAs. The heterogeneity of uses, both between and within consumptive and non-consumptive categories make it unlikely that any one design will satisfy all user groups. The design will need to make some explicit provisions for trading off among the various negative and positive impacts on user groups. Placement of MPAs should also take into account the adjacent terrestrial environment and associated human activities. Freshwater runoff can be an important source of nutrients but also a potential source of contaminants to the adjacent marine environment. Terrestrial protected areas (e.g., preserves, parks) can regulate human access, restrict discharge of contaminants and provide enforcement support to adjoining MPAs.

### **4. *MPA permanence is especially critical for long lived animals***

Two clear objectives for establishing self-sustaining MPAs are to protect areas that are important sources of reproduction (nurseries, spawning areas, egg sources) and to protect areas that will receive recruits and thus be future sources of spawning potential. To meet the first objective of protecting areas that serve as sources of young, protection should occur both for areas that historically contained high abundances and for areas that currently contain high abundances. Historically productive fishing areas, which are now depleted, are likely to show a larger, ultimate response to protective measures if critical habitat has not been damaged. Protecting areas where targeted populations were historically abundant alone is insufficient, however, because the pace of recovery may be slow, especially for species with relatively long life spans and sporadic recruitment (for example, top marine predators). Including areas with currently high abundances in an MPA network helps buffer the network from the inevitable time lag for realizing the responses of some species. The biological characteristics of longevity and sporadic recruitment also suggest that the concept of a rotation of open and closed areas will probably not work well for the diversity of coastal species in California.

## **5. Size and shape guidelines** (See references noted “D” in literature cited)

To provide any significant protection to a target species, the size of an individual MPA must be large enough to encompass the typical movements of many individuals. Movement patterns vary greatly among species. Some are completely immobile or move only a few meters. Others forage widely. The more mobile the individuals, the larger the individual MPA must be to afford protection. Therefore, minimum MPA size constraints are set by the more mobile target species. Because some of California's coastal species are known to move hundreds of miles, MPAs of any modest size are unlikely to provide a high degree of protection for these species. Fortunately, tagging studies indicate that net movements of many of California's nearshore bottom-dwelling fish species, particularly reef-associated species, are on the order of 5-20 km (3-12.5 m or 2.5-11 nm) or less over the course of a year (Lea et al. 1999). Knowledge of these individual adult neighborhood or home range sizes must be combined with knowledge of how individuals are distributed relative to one another (e.g., in exclusive versus overlapping neighborhoods) to determine how many individuals a specific MPA design will protect. Current data suggest that MPAs spanning less than about 5-10 km (3-6 m or 2.5-5.4 nm) in extent along coastlines may leave many individuals of important species poorly protected. Larger MPAs, spanning 10-20 km (6-12.5 m or 5.4-11 nm) of coastline, are probably a better choice given current data on adult fish movement patterns.

In an MPA network it is relatively easy to protect non-mobile species, and relatively difficult to protect species whose ranges generally extend beyond MPA boundaries. This is due to the fact that highly mobile species will spend the majority of their lives outside the protected area and thus receive little added protection by its establishment. Non-mobile species, conversely, may spend their entire life within the protected area and be completely protected from human take. In light of this, special consideration in MPA network design is paid to species with intermediate mobility, which will not only receive significant protection but also be available for take when outside MPA boundaries. With MPAs spanning 10-20 km of coastline, pelagic species with very large neighborhood sizes will likely receive little protection unless the MPA network as a whole affords significant reductions in mortality during the cumulative periods that individuals spend in different MPAs, or unless other ecological benefits are conferred (e.g., protection of feeding grounds, reduction in bycatch). Protection for highly mobile species will come from other means, such as state and federal fisheries management programs, but MPAs may play a role.

Less is known about the net movements of most of the deeper water sedentary and pelagic fishes, especially those associated with soft-bottom habitat, but it is reasonable to suspect that the range of movements will be similar or greater than those of nearshore species. One cause of migration in demersal fishes is the changing resource/habitat requirements of individuals as they grow. Thus, individual ranges can reflect the gradual movement of an individual among habitats, and MPAs that encompass more diverse habitat types will more likely encompass the movement of an individual over its lifetime. Although fisheries may not target younger fish, offshore MPAs that include inshore nursery habitats increase the likelihood of replenishment of adult populations offshore. Such MPAs would also protect younger fish from incidental take (i.e. bycatch). Fish with moderate movements, especially those in deeper water, will require larger MPA sizes. Because several species also move between shallow and deeper habitat, MPAs that extend offshore (from the coastline to the three-mile offshore boundary of State waters) will accommodate such movement and protect individuals over their lifetime.

Typically, the relative amount of higher relief rocky reef habitat decreases with distance from shore. In such situations, a MPA shape that covers an increasing area with distance offshore (i.e., a wedge shape) may be an effective design. This shape also better accommodates the greater movement ranges of deeper water and soft-bottom associated fishes and the larval/juvenile stages of nearshore species which may occur offshore during their planktonic phase of life. However, this may conflict with the optimum design for enforcement purposes of using lines of latitude and longitude for boundaries.

Coupling of pelagic and benthic habitats is an important consideration in both offshore and nearshore MPA design. The size of a protected area should also be large enough to facilitate enforcement and to limit deleterious edge effects caused by fishing adjacent to the MPA. MPA shape should ultimately be determined on a case-by-case basis using a combination of information about bathymetry, habitat complexity, species distribution, and relative abundance.

## **6. Spacing between MPAs** (See references noted “E” in literature cited)

The exchange of larvae among MPAs is the fundamental biological rationale for MPA “networks”. Larval exchange has at least three primary objectives: to assure that populations within MPAs are not jeopardized by their reliance on replenishment from less protected populations outside MPAs; to ensure exchange and persistence of genetic traits of protected populations (e.g., fast growth, longevity); and to enhance the independence of populations and communities within MPAs from those outside MPAs for the use of MPAs as reference sites. One role of MPAs is to act as reference sites for comparison with less protected populations or communities. For this to occur, MPAs must act independently from areas with less protected populations. Independence is enhanced for MPAs whose replenishment is contributed to by other MPAs.

Movement out of, into and between MPAs by juveniles, larvae, eggs, or spores of marine species depends on their dispersal distance. Important determinants of dispersal distance are the length of the planktonic period, oceanography and current regimes, larval behavior, and environmental conditions (e.g., temperature and sources of entrainment). As with adult movement patterns, the dispersal of juveniles, larvae and eggs varies enormously among species. Some barely move from their natal site. Others disperse vast distances. MPAs will only be connected through the dispersal of young if they are close enough together to allow movement from one MPA to another. Any given spacing of MPAs will undoubtedly provide connectivity for some species and not for others. The challenge is minimizing the number of key or threatened species that are left isolated by widely spaced MPAs.

Based on emerging genetic data from species around the world, larval movement of 50-100 km appears common in marine invertebrates (Kinlan et al. 2005; Kinlan and Gaines 2003; Shanks et al. 2003; Siegel et al. 2003). For fishes, larval neighborhoods based on genetic data appear generally larger, ranging up to 100-200 km. For marine birds and mammals, dispersal of juveniles of hundreds of km is not unusual, but for some of these species, return of juveniles to natal areas can maintain fine-scale population structure. For MPAs to be within dispersal range for most commercial or recreational groundfish or invertebrate species, they will need to be on the order of 50-100 km apart. Otherwise, a large fraction of coastal species will gain no benefits from connections between MPAs.



Current patterns, retention features such as fronts, eddies, bays, and the lees of headlands may create “recruitment sinks and sources”. Such spatial variation in recruitment habitat may be predictable - dispersal distances will be shorter where retention is substantial (e.g., lees of headlands). As a result, MPAs may need to be more closely spaced in these settings.

Although dispersal data appear to be valid for a wide range of species, there are few coastal marine species in California that allow these estimates of larval neighborhoods to be made with confidence. Nonetheless, the specific pattern of larval dispersal in any particular species is not as important for network design as the sum of all the patterns of larval dispersal for all the species of concern.

## ***7. Minimal replication of MPAs***

MPAs in a particular habitat type need to be replicated along the coast. Four major reasons for this are: to provide stepping-stones for dispersal of marine species; to insure against local environmental disaster (e.g. oil spills or other catastrophes) that can significantly impact an individual, small MPA; to provide independent experimental replicates for scientific study of MPA effects; and for the use of MPAs as reference sites to evaluate the effects of human influences on populations and communities outside MPAs. Ideally at least five replicates (but a minimum of three) containing sufficient representation of each habitat type, should be placed in the MPA network within each biogeographical region and for each habitat to serve these goals. For large biogeographical regions, fulfilling the critical stepping stone role may require even more MPA replicates. The spacing criteria discussed above will drive the number of replicates in this situation. To ensure that the effects of MPAs can be quantified, the network should be designed in a way that facilitates comparison of protected and unprotected habitats, and between different degrees of consumptive and non-consumptive uses.

## ***8. Human activities ranges and MPA placement***

The geographic extent of human activities is suggestive of size and placement of MPAs. Fishing fleets and other user groups typically have a finite home range from ports and access points along the coast. Many activities, especially in central California, are day-based and conducted from motor-, sail- or hand-powered crafts with ranges between 1 and 29 miles (1 and 25 nautical miles). Historical patterns of fishing activity may have been concentrated much closer to ports than is true today because of declines in target species abundance from activities in the past. If MPAs are designed to limit consumptive uses, MPAs located farthest away from access points will tend to be associated with lower negative impacts. However, MPAs often become magnets for fishing along their edges. These situations create positive impacts for consumptive users by locating MPAs close to ports and coastal access points. Similarly, MPAs designed to facilitate certain non-consumptive types of activities such as diving may be more effective closer to ports and coastal access points. As a general rule, locating MPAs at the outer reaches of the maximum range of any given user group will tend to minimize the impacts on that group, both negative (loss of opportunity) and positive (creation of opportunity). The balance between these influences must be evaluated for specific locations. In addition, if MPAs restrict transit they will carry higher social, economic and, potentially, safety costs for users seeking access to sites beyond the MPA. For these reasons, it is recommended that, in general, MPAs do not restrict transit.

## **9. Human activity patterns**

Human activities have distinct hotspots where effort is concentrated. In certain cases there may be an ecological benefit from eliminating certain activities while their may be socioeconomic benefit from allowing others. Areas of intense use will not only be those most impacted by human perturbation of the ecosystem but also those where eliminating certain consumptive uses may cause high levels of short-term economic impact. It is recommended that proposals consider, in their design, areas of intensive human use and the cost and benefit of establishing MPAs in these areas.

### ***Consideration of Habitats in the Design of MPAs (See additional references noted "F" in literature cited)***

The first step in assembling alternative proposals for MPAs in a region and in the context of a statewide MPA network is to use existing information to the extent possible to identify and to map the habitats that should be represented. The MLPA also calls for recommendations regarding the extent and types of habitats that should be represented.

The MLPA identifies the following habitat types: rocky reefs, intertidal zones, sandy or soft ocean bottoms, underwater pinnacles, seamounts, kelp forests, submarine canyons, and seagrass beds. The Master Plan Team convened in 2000 reduced this basic list by eliminating seamounts, since there are no seamounts in state waters. The team also identified four depth zones as follows: intertidal, intertidal to 30 meters, 30 meters to 200 meters, and beyond 200 meters. Several of the seven habitat types occur in only one zone, while others may occur in three or four zones. While pelagic habitats are also important from an ecosystem perspective, they are more difficult to include in a network of MPAs due to the transitory nature of the water and its inhabitants, both of which are not constrained by lines on a map.

The science team recommends expanding these habitat definitions in several ways:

1. Based on information about fish depth distributions provided in a new book on the ecology of California marine fishes (Allen et al. in press), the science team recommends dividing the 30-200 m depth zone into a 30-100 m and a 100-200 m zone. This establishes five depth zones for consideration:
  - Intertidal
  - Intertidal to 30 m (0 to 16 fm)
  - 30 to 100 m (16 to 55 fm)
  - 100 to 200 m (55 to 109 fm)
  - 200 m and deeper
2. The habitats defined in the MLPA implicitly focus on open coast ecosystems and ignore the critical influence of estuaries. California's estuaries contain most of the State's remaining soft bottom and herbaceous wetlands such as salt marshes, sand and mud flats, and eelgrass beds. Ecological communities in estuaries experience unique physical gradients that differ greatly from those in more exposed coastal habitats. They harbor unique suites of species, are highly productive, provide sheltered areas for bird and fish feeding, and are nursery grounds for the young of a wide range of coastal species. Emergent plants filter sediments and nutrients from the watershed, stabilize

shorelines, and serve as buffers for flood waters and ocean waves. Given these critical ecological roles and ecosystem functions, estuaries warrant special delineation as a critical California coastal habitat.

3. Three of the habitats defined in the MLPA – rocky reefs, intertidal zones, and kelp forests – are generic habitat descriptions that include distinct habitats that warrant specific consideration and protection. In the case of rocky reefs and intertidal zones, the type of rock that forms the reef greatly influences the species using the habitat. For example, granitic versus sedimentary rock reefs harbor substantially different ecological assemblages and should not be treated as a single habitat. Similarly, the term kelp forest is a generic term that subsumes two distinct ecological assemblages dominated by different species of kelp. Kelp forests in the southern half of the state are dominated by the giant kelp, *Macrocystis pyrifera*. By contrast, kelp forests in the northern half of the state are dominated by the bull kelp, *Nereocystis luetkeana*. In central California, both types of kelp forests occur. These two types of kelp forests harbor distinct assemblages and should be treated as separate habitats.
4. Habitat definitions in the MLPA should be expanded to include ocean circulation features, because habitat is not simply defined by the substrate. Seawater characteristics are analogous to the climate of habitats on land, and play a critical role in determining the types of species that can thrive in any given setting. Just as features of both the soil and atmosphere characterize habitats on land, features of both the substrate (e.g., rock, sand, mud) and the water that bathes it (e.g., temperature, salinity, nutrients, current speed and direction) characterize habitats in the sea. No one would argue that a sand dune at the beach and a sand dune in the desert are the same habitat. Similarly, rocky reefs in distinct oceanographic settings are different habitats that can differ fundamentally in the species that use the reefs.
5. There are often multiple habitat types within a relatively small area, and these are often incorporated into proposed MPAs. The science team distinguished these habitat types using the highest resolution bathymetry data available, when calculating percent of each habitat within proposed MPAs. For the purposes of linking habitats within a network or network component, each MPA was characterized by the habitats that it includes in an ecologically meaningful amount. For the purpose of evaluating whether habitats are adequately represented within individual MPAs, the following factors must be considered: the relative amount of that habitat in the entire region, the overall size of the MPA, and the home range of species likely to benefit from protection in an MPA that rely upon that habitat.
6. In the central coast region, high-resolution bathymetric imagery data are not available for most of the southern half of the region. Coarse-scale bathymetry data indicated that a large portion of the region was soft bottom, yet commercial and recreational fishing effort data for rockfishes associated with hard bottom, as well as anecdotal information from fishermen and other constituents, indicated that considerable hard bottom exists within state waters. Maps derived from recreational CPFV fishing data for rockfish trips and maximum extent of kelp should be used to develop proxies for the location of hard-bottom habitat for any region in which high resolution maps do not exist; these in turn should be used for habitat calculations for proposed MPAs.

The oceanography of the California coastline is dominated by the influence of the California Current System. On the continental shelf and slope this system consists of two primary currents - the California Current, which flows toward the equator, and the California

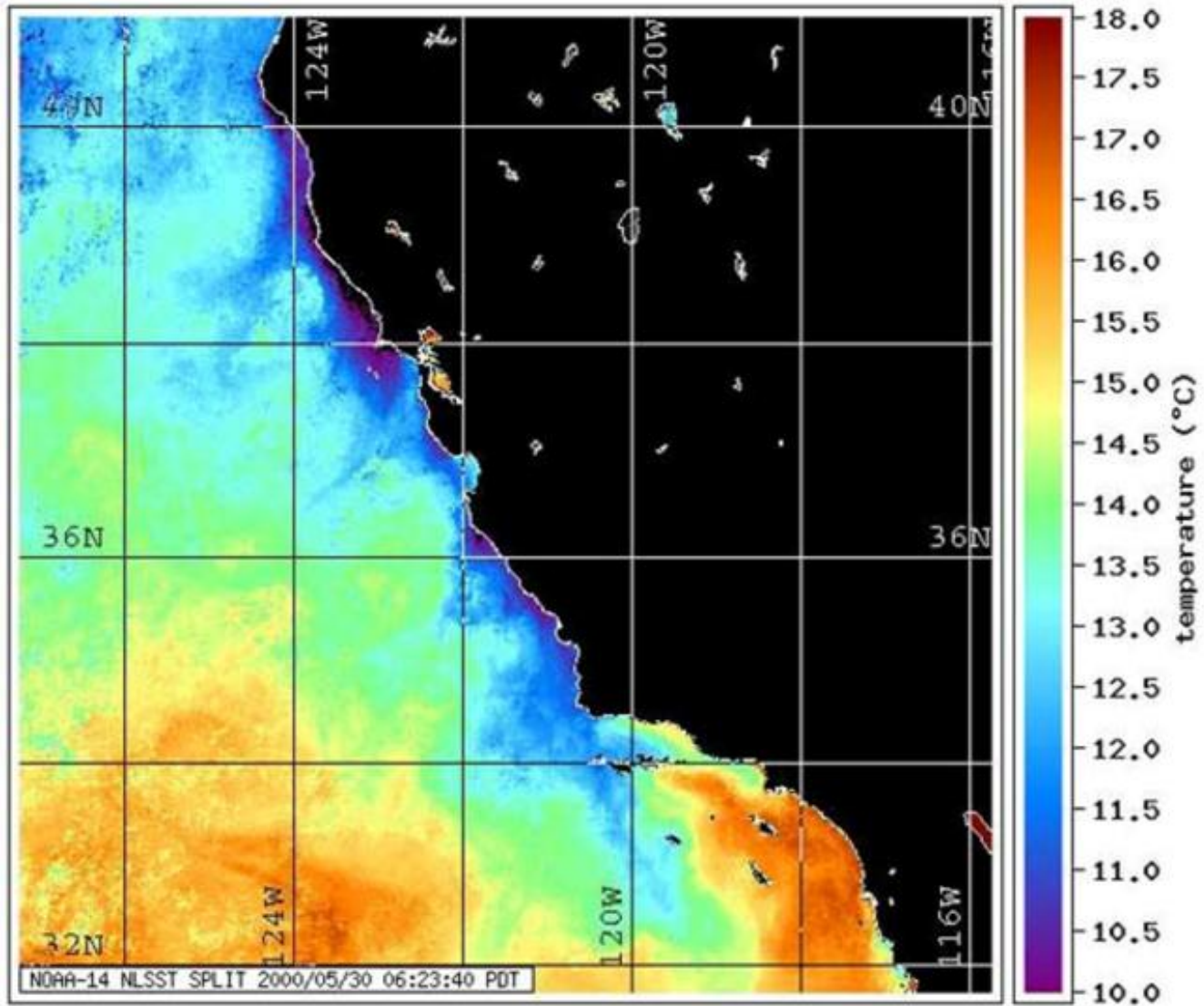
Undercurrent, which flows toward the North Pole (Hickey, 1979; 1998). When present, the undercurrent occurs beneath the southward flowing California Current. North of Pt. Conception, the undercurrent may reach the surface as a nearshore, poleward flowing current that is best developed in fall and winter (Collins et al., 2000; Pierce et al., 2000). These currents vary in intensity and location, both seasonally and from year to year.

Organisms will also be affected by the circulation induced by tidal currents. For those living in shallow water habitats very close to shore, inshore of the surf zone, the dominant influence on transport of planktonic eggs and larvae will be the circulation generated by breaking waves.

As can be seen in a satellite image of ocean temperature along the California coastline (Figure 4), the circulation and physical characteristics of the California Current System are exceedingly complex and variable. This is not the image one would expect if ocean currents were analogous to northward or southward flowing rivers in the sea. Rather, ocean flows are greatly modified by variation in the strength and direction of winds, ocean temperatures and salinity, tides, the topography of the coastline, and the shape of the ocean bottom, among several other factors. The end result is a constantly changing sea of conditions.

The patterns are not completely random, however. Many aspects of ocean climates vary somewhat predictably in space, especially ones that are tied to key features of the coastline – points and headlands, river mouths, etc. Locations that share similar ocean climates are typically more similar in the types of species they harbor. Therefore, defining habitats for the MLPA and MPA networks must include habitats defined by coastal oceanography as well as the composition of the seafloor.

Figure 4. An example of sea surface temperature in the California coastal waters, May 30, 2000.



Although a wide range of oceanographic habitats could be defined for the California coastline, the science team suggests that three prominent habitats stand out because of their demonstrated importance to different suites of coastal species:

- Upwelling centers
- Freshwater plumes
- Retention areas

It is not recommended that such features (some of which are of very large scale) be isolated as habitats to be designated as MPAs or specifically encompassed within MPAs. However, MPAs could be designated that included or benefited from the presence or proximity of such features and processes.

## *Upwelling Centers*

Upwelling is one of the most biologically important circulation features in the ocean. Upwelling occurs when deep water is brought to the surface. On average deep water is colder and more nutrient rich than surface waters. When upwelling delivers nutrients to the sunlit waters near the surface, it provides the fuel for rapid growth of marine plants, both plankton and seaweeds. Ultimately the added nutrients can energize the productivity of entire marine food webs. Upwelling regions are the most productive ocean ecosystems. The west coast of North America is one of the few major coastal upwelling regions on the entire planet (Chavez and Collins, 2000; Hickey, 1998). The major driver of upwelling along the California coastline is wind. Winds that blow from the north and northwest parallel to California's generally north-south coastline drive currents at the surface. Because of the complicated effects of friction and the rotation of the earth, surface water is pushed to the right of the direction of the wind (the Coriolis Effect). With winds blowing from the north and northwest, this effect pushes surface waters away from shore. As water is pushed offshore, it is replaced by water that is upwelled from below.

The rate of upwelling depends on many features that vary spatially along the coastline – the strength and direction of the wind, the topography of the shoreline, and the shape of the continental shelf are three of the most important. Capes and headlands play a key feature in all of these drivers of upwelling. They accelerate alongshore winds, and they channel coastal currents in such a way that upwelling intensity can increase dramatically in their vicinity. As a result, major headlands and capes from Pt. Conception north are commonly centers of upwelling associated with strong rates of offshore transport of surface waters, greatly elevated nutrient concentrations, and enhanced productivity offshore (Pickett and Paduan, 2003). Since major capes and headlands tend to be fairly regularly spaced along the California coastline, with an average spacing between 150 and 200 km (93 and 124 m or 81 and 108 nm), these upwelling centers drive cells of ocean circulation with relatively predictable patterns of flow. Enhanced offshore flow and upwelling emanates from headlands, versus eddies and locations of more frequent alongshore flow in the regions between headlands. These filaments of upwelled water are readily identified emanating from key headlands in most satellite images of ocean temperature or biomass of phytoplankton. Because the upwelling centers are locations of more frequent and intense offshore flow near the surface, which moves larvae and other plankton away from shore, and elevated nutrients, which fuels much more rapid algal productivity, these locations represent a distinct oceanographically driven coastal habitat with substantially different species composition and dynamics compared to other coastal locations.

## *Freshwater Plumes*

A second coastal habitat driven by features of the water column is generated by the influence of rivers. Freshwater emerging from watersheds alters the physical characteristics of coastal seawater (especially salinity), changes the pattern of circulation (by altering seawater density), and delivers a variety of particles and dissolved elements, such as sediments, nutrients, and microbes. These effects all arise from the land and can have a profound influence on the success of different marine species. The mouths of watersheds set the locations of low salinity plumes, and the size and shape of the plume vary over time as functions of the volume of flow from the watershed, the concentration of particles, and the nature of coastal circulation into which the water is released. The location of California's freshwater plume habitats can be

defined by both satellite and ocean-based measurements. In other parts of the country (e.g. Mississippi River delta) and the state (e.g. San Francisco Bay estuarine complex) the influence of this habitat type is much greater than it is in regions such as the central California coast south of San Francisco.

### *Larval Retention Areas*

Since connectivity and movement of larvae, plankton, and nutrients play such an important role in the impact of MPAs on different species, changes in the speed and direction of coastal currents can create very different ecological settings. A number of circulation features can greatly limit the coastal particles. In particular, features characterized by rotational flows, such as eddies, can greatly enhance the length of time that a particle or larval fish stays in a general region of the coastline. Such retentive features have been shown to significantly affect the species composition of coastal ecosystems (Largier, 2004). Since many retention areas are tied to fixed features of coastal topography (e.g., eddies in the lee of coastal headlands or driven by bottom topography), they define unique regions of coastal habitat that can be predictably defined.

Experience in California and elsewhere demonstrates that individual MPAs generally include several types of habitat in different depth zones, so that the overall number of MPAs required to cover the various habitat types can be smaller than the number of total habitats. The Master Plan Team convened in 2000 also called for considering adjacent lands and habitat types, including seabird and pinniped rookeries. Since marine birds and mammals are protected by federal regulations, they are not a primary focus of the MLPA. Nonetheless, these species can play important ecological roles and their success may be impacted by changes in other components of California's coastal ecosystems that are a primary focus of MLPA. Therefore, MPA planning needs to coordinate with other efforts focused on marine birds and mammals.

As noted regarding the design of MPAs, this guidance should be the starting point for regional discussions regarding representative habitats in a region. Although this guidance is not prescriptive, any significant deviation from it should be explained.

### ***Species Likely to Benefit from MPAs***

Recommending the extent of habitat that should be included in an MPA network will require careful analysis and consideration of alternatives. These recommendations may vary with habitat and region, but should be based on the best readily available science. One aspect of determining appropriate levels of habitat coverage is the habitat requirements of species likely to benefit from MPAs in a region. California Fish and Game Code subsection 2856(a)(2)(B) requires that the master plan identify "select species or groups of species likely to benefit from MPAs, and the extent of their marine habitat, with special attention to marine breeding and spawning grounds, and available information on oceanographic features, such as current patterns, upwelling zones, and other factors that significantly affect the distribution of those fish or shellfish and their larvae."

The Department prepared a master list of such species, which appears in Appendix G. This list may serve as a useful starting point for identifying such species in each region during the development of alternative MPA proposals. With the assistance of the science team, the

Department should develop a list of species specific to each study region of the state, as they are determined, for use by the appropriate regional stakeholder group. The list will indicate which species are of critical concern and why. This regional list then can assist in evaluating desirable levels of habitat coverage in alternative MPA proposals. Although the statewide list will be all inclusive, it is not likely that all species on the list will benefit from the establishment of new, or the expansion of existing, MPAs. For example, a species may be in naturally low abundance within this portion of its geographical range.

The Department, with the assistance of the science team, will develop scientifically based expectations of increases in abundance of focal species for each MPA. These expectations, while not hard targets or performance goals, will help managers determine the efficacy of MPAs. If expected increases are not realized, the process of adaptive management will allow for changes in the MPA design.

### ***Biogeographical Regions***

In calling for a statewide network of MPAs, to the extent possible, the MLPA recognizes that the state spans several biogeographical regions, and identified these, initially, as follows [FGC subsection 2852(b)]:

- The area extending south from Point Conception,
- The area between Point Conception and Point Arena, and
- The area extending north from Point Arena.

In the same provision, the MLPA provides authority for the master plan team required by FGC subsection 2855(b)(1) to establish an alternate set of boundaries. The Master Plan Team convened by the Department in 2000 determined that the three regions identified in the MLPA were not zoogeographic regions; scientists recognize only two zoogeographic regions between Baja California and British Columbia with a boundary at Pt. Conception. Instead of the term “biogeographical region,” the team adopted the term “*marine region*” and identified four *marine regions*:

- North marine region: California-Oregon border to Point Arena (about 210 linear miles or 183 linear nautical miles of coastline);
- North-central marine region: Point Arena to Point Año Nuevo (about 180 linear miles or 156 linear nautical miles of coastline);
- South-central marine region: Point Año Nuevo to Point Conception (about 233 linear miles or 203 linear nautical miles of coastline); and
- South marine region: Point Conception to the U.S./Mexico border, including the islands of the southern California Bight (about 280 linear miles or 243 linear nautical miles of coastline).

Three of the above four regions (those north of Point Conception) fall within the larger zoogeographic region accepted by scientists. These sub-regions were used more or less as subdivisions of the greater zoogeographic region by the former Master Plan Team. Technically, the requirement of replicate state marine reserves encompassing a representative variety of habitat types and depths would only apply to the two recognized zoogeographic regions within the state. However, based on the concept of a network of MPAs, in whatever



way it is defined, and the fact that it would likely require unusually and unacceptably large state marine reserves to incorporate a wide variety of habitat types if only two (the minimum definition of “replicate”) state marine reserves were established in each zoogeographic region, it is likely that a statewide network will contain more than two state marine reserves in each biogeographical region.

MPAs in different biogeographical regions will affect different suites of species. Thus replication and network design may be considered separately for relatively distinct stretches of coastline. Biogeographical regions can be distinguished based upon data of two types: 1) the location of species’ borders along the coastline; and 2) surveys of species’ distribution and abundance. Historically, the locations of species’ borders, i.e., places where multiple species terminate their ranges, have been used to define biogeographical regions or provinces. However, regional boundaries typically are set by only small subset of the species distributed up and down coast from these “breakpoints”.

The abundances and diversity of species at locations along the coast are much more reflective of differences in biological communities and provide the best evidence of biologically distinct regions from both structural and functional standpoints. Historically, such data on abundance and biological diversity have not been available at enough locations along most coastlines for broad scale, geographic analyses. As a result, definitions of biogeographical regions have been forced to rely on a less meaningful measure of biological differences – the location of species’ borders.

Biogeographers have divided all major oceans into large *biogeographic provinces*. California’s coastline spans two of these large-scale provinces – the Oregonian and the Californian Provinces – with a boundary in the vicinity of Point Conception. This prominent biogeographical boundary has been recognized for more than half a century. More detailed analyses of species’ borders also have led to the identification of regional scale boundaries between biogeographical sub-provinces.

Biogeographers commonly have used distributional data for subgroups of taxonomically related species (e.g., snails, seaweeds, or fish) to set biogeographical boundaries; interestingly, the boundaries for sub-provinces often differ among taxonomic groups because different types of species respond to different physical and biological characteristics in different ways (Airamé et al. 2003). Two locations, however, emerge as prominent boundaries for key coastal species. Seaweeds, intertidal invertebrates, and nearshore fishes have comparable numbers of species’ borders in the vicinity of Monterey Bay as they do at Point Conception. In addition, coastal fishes have an important sub-province boundary at Cape Mendocino.

Scientific data do not support a significant biological break between biogeographical regions at Point Arena, as identified in earlier MHPA documents. Therefore, on the basis of the distribution of species’ borders for key coastal species groups, there are three biogeographical regional boundaries and four regions along the California coast:

1. The U.S./Mexico border to Point Conception,
2. Point Conception to Monterey Bay,
3. Monterey Bay to Cape Mendocino, and
4. Cape Mendocino to the California/Oregon border.

In the past decade, detailed data have become available on species abundances and diversity from a large number of locations along California's coast. This wealth of information on actual species assemblages now provides the opportunity to define biogeographical regions on the basis of actual ecosystem compositions, rather than the presumed composition of ecosystems inferred from species' borders. These ecosystem-based data are a better scientific fit with the goals of the MLPA. Summaries of species abundance and diversity data, especially for shallow water species (<30 m depth), suggest that there are four points of transition along the California coastline that demarcate distinct marine assemblages: Point Conception, Monterey Bay, San Francisco Bay, and Cape Mendocino.

Three of these locations are identical to those defined above solely on the basis of species' borders for prominent groups. The new boundary that emerges from abundance and biodiversity data is San Francisco Bay. The region between Monterey Bay and Cape Mendocino has two distinct biological assemblages on coastal reefs even though this is not a region characterized by large numbers of species' borders. The difference in assemblages on either side of San Francisco Bay appears to be caused by changes in the types of rock that form nearshore reefs. Since the type of rock is used to define bottom habitats for MPA designation, this transition in species composition could be addressed in MPA designs using habitat considerations or, alternatively by designating the Monterey Bay to San Francisco Bay segment as a distinct biogeographical region.

Based on this review, there are four possible definitions of the biogeographical regions that will serve as the basic structure of the statewide network of MPAs. These options are as follows:

1. The three biogeographical regions defined in the MLPA;
2. The two *biogeographic provinces* recognized by many scientists with a boundary at Point Conception;
3. The four *marine regions* identified by the former Master Plan Team, with boundaries at Point Conception, Point Año Nuevo, and Point Arena; and
4. The biogeographical regions recognized by scientists who have identified borders based on species distributional patterns or on abundance and diversity data with boundaries at Point Conception, Monterey Bay and/or San Francisco Bay, and Cape Mendocino.

Accepting the strong scientific consensus of a major biogeographical break at Point Conception, the MLPA Blue Ribbon Task Force recommended that the Commission adopt the two biogeographic provinces as the biogeographical regions for purposes of implementing the Marine Life Protection Act. The task force recommended that the more refined information on other breaks be used in designating study regions and in designing networks of MPAs. These recommendations were adopted by the Commission in August 2005 within the Master Plan Framework and are not changed in this Master Plan.

### ***Types of MPAs***

The MLPA recognizes the role of different types of MPAs in achieving the objectives of the Marine Life Protection Program [FGC subsection 2853(c)]. While the MLPA does not define the different types, the Marine Managed Areas Improvement Act (MMAIA) defines all types of

MMAAs including the three MPAs (state marine reserve, state marine park, and state marine conservation area) and one MMA (state marine recreational management area) used in the Master Plan for MLPA implementation (See Appendix B for the text of the MMAIA as amended).

Besides somewhat different purposes, which are described below, each type of MPA represents a different level of restriction on activities within MPA boundaries. These restrictions and purposes suggest how each designation can be used effectively in a network of MPAs.

### *State Marine Reserve*

As defined in the MMAIA, a state marine reserve prohibits injuring, damaging, taking or possessing any living, geological, or cultural resources and must maintain the area “to the extent practicable in an undisturbed and unpolluted state” while allowing “managed enjoyment and study” by the public [PRC subsection 36710(a)]. The responsible agency may permit research, restoration, or monitoring. Such activities as boating, diving, research, and education may be allowed, to the extent feasible, so long as the area is maintained “to the extent practicable in an undisturbed and unpolluted state.” Such activities may be restricted to protect marine resources. It specifically allows the agency to permit scientific activities. The definition of “marine life reserve” in the MLPA is consistent with this definition.

The MLPA and MMAIA thus require striking a balance between protection and access in marine reserves. The form that this balance takes in an individual marine reserve will depend upon the goals and objectives of that reserve. While the MLPA specifically precludes commercial and recreational fishing from marine reserves, it also authorizes restrictions on other activities, including non-extractive activities (e.g., diving, kayaking, snorkeling, etc.). Any such restrictions, however, must be based on specific objectives for an individual site and the best readily available science. It is important to note that this statement does not imply that navigation will necessarily be restricted though MPAs or that other non-extractive activities will be regulated, although in some instances the latter may be necessary. For example, it may be necessary to protect populations of sensitive marine birds or mammals in their nesting or breeding areas by prohibiting access to some areas.

The MLPA sets other requirements for the use of marine reserves. At FGC subsection 2857(c)(3), the MLPA requires “[s]imilar types of marine habitats and communities shall be replicated, to the extent possible, in more than one marine life reserve in each biogeographical region.” Consistent with this approach, this Master Plan Framework foresees that in each biogeographical region described above, representative habitat across a range of depths should be represented in at least two marine reserves in order to assure the replication of habitats required by the MLPA. It should be noted that several of habitat types occur in only one depth zone, while others may occur in three or four depth zones. Experience demonstrates that individual MPAs generally include several types of habitat in different depth zones, so the overall number of marine reserves required to replicate the various habitat types may be less than the total combination of depth zones and habitats replicated across each region.

## State Marine Park

As defined in the MMAIA, a state marine park prohibits injuring, damaging, taking or possessing for commercial use any living or nonliving marine resources. Other uses that would compromise the protection of living resources, habitat, geological, cultural, or recreational features may be restricted. All other uses are allowed, consistent with protecting resources.

State marine parks, hereafter called “marine parks”, differ from marine reserves to different degrees in their purposes as well as the type of restrictions. Unlike marine reserves, marine parks allow some or all types of recreational fishing. The types of restrictions on fishing may vary with the focal species, habitats, and goals and objectives of an individual marine park within a region. Where the primary goal is biodiversity conservation, restrictions on fishing may be different from those in a marine park where the primary goal is enhancing recreational opportunities.

## State Marine Conservation Area

In a state marine conservation area, activities that would compromise the protection of species of interest, the natural community<sup>5</sup>, habitat, or geological features may be restricted. Research, education, and recreational activities, as well as commercial and recreational fishing may be permitted.

State marine conservation areas, hereafter called “marine conservation areas”, also differ from marine reserves in their purpose as well as the type of restrictions. This type of MPA allows some level of recreational and/or commercial fishing. The restrictions on fishing may vary with the focal species, habitats, and goals and objectives of an individual MPA within a region, and may, for instance, be in the form of restrictions on the catch of particular species or on the use of certain types of fishing gear. Marine conservation areas may be useful in protecting more sedentary, benthic species, while allowing the harvest of pelagic finfish<sup>6</sup> species. Another use of a marine conservation area would be to allow the continued use of traps (which typically have relatively low bycatch rates and are more efficient for harvesting invertebrates) while prohibiting the harvest of finfish species of concern by hook-and-line or by trawls (which typically have relatively high bycatch rates). At present the large fishery closures known as the Cowcod Conservation Areas and the Rockfish Conservation Area may function as *de facto* marine conservation areas in that bottom fishing for finfishes is prohibited but other types of fishing are allowed, though the specific regulations in these areas are subject to change dependent on stock assessments.

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<sup>5</sup> Natural community is defined in Fish and Game Code section 2702(d) as a distinct, identifiable, and recurring association of plants and animals that are ecologically interrelated.

<sup>6</sup> Pelagic Finfish are defined in California regulation as: northern anchovy (*Engraulis mordax*), barracudas (*Sphyraena* spp.), billfishes\* (family Istiophoridae), dolphinfish (*Coryphaena hippurus*), Pacific herring (*Clupea pallasii*), jack mackerel (*Trachurus symmetricus*), Pacific mackerel (*Scomber japonicus*), salmon (*Oncorhynchus* spp.), Pacific sardine (*Sardinops sagax*), blue shark (*Prionace glauca*), salmon shark (*Lamna ditropis*), shortfin mako shark (*Isurus oxyrinchus*), thresher sharks (*Alopias* spp.), swordfish (*Xiphias gladius*), tunas (family Scombridae), and yellowtail (*Seriola lalandi*).

## *State Marine Recreational Management Area*

In a state marine recreational management area, activities which would compromise the recreational value of the area are restricted. Recreational opportunities may be protected, enhanced, or restricted, while preserving basic resource values of the area. While not specifically a marine protected area, these marine managed areas are useful for consideration in areas where certain recreational use is allowed while extraction of subtidal living marine resources is prohibited. Specifically, these areas can be used where allowing waterfowl hunting is consistent with the desired level of subtidal resource protection. The use of this designation can specifically allow hunting, while preserving the subtidal resources in a manner similar to a state marine reserve.

## *Combined use of marine reserves, marine parks and marine conservation areas*

The combination of the use of marine reserves, marine parks and marine conservation areas has an especially valuable role to play in designing a network that accommodates a spectrum of uses (NRC 2001; Salm et al. 2000). In the design of MPAs, plans that use all three types of MPAs may allow separation of incompatible uses (NRC 2001). For instance, a marine reserve could be buffered with a marine park in which some types of recreational fishing are regulated but allowed or with a marine conservation area where limited recreation and commercial fishing are allowed. The buffer zone may allow the full benefit of spillover to be realized in the limited-take area.

This approach may, however, prove to be problematic relative to the enforcement and public understanding of different regulations within contiguous areas. Confusing differences in regulations in a small spatial area can lead to unintentional infractions and a degradation of the function of the MPA. Care must be taken to ensure that regulations are understandable and observed by the public and enforced as necessary.

## **Levels of Protection for MPA Classifications**

The MLPA Master Plan Science Advisory Team recognized that there is great variation in the type and magnitude of activities that may be permitted within the three types of MPAs, in particular SMPs and SMCAs. This variety intentionally provides designers of MPA network components with flexibility in proposing MPAs that either individually or collectively fulfill the various goals and objectives specified in the MLPA. However, this flexibility can result in complex and possibly confusing levels of protection afforded by any individual MPA or collection of MPAs. In particular, SMCAs allow for many possible combinations of recreational and commercial extractive activities. Therefore, MPA network component proposals with similar numbers and sizes of SMCAs may in fact differ markedly in the type, degree, and distribution of protection throughout the study region. Thus, the purpose of categorizing MPAs by their relative level of protection is to simplify comparisons of the overall conservation value of MPAs within and among proposed network components.

## Rationale for categories of protection

MPA proposals should be evaluated particularly with respect to five of the six MLPA goals: 1, 2, 3, 4, and 6. **Goal 1** addresses protection of the natural diversity and abundance of marine

life, and the structure, function, and integrity of marine ecosystems. **Goal 2** aims to help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted. One aspect of **Goal 3** that should be evaluated is the opportunity to study marine ecosystems that are subject to minimal human disturbances. As related to this goal, proposals should be evaluated with respect to the replication of appropriate MPA designations, habitats, and control areas. **Goal 4** pertains to the protection of marine natural heritage, including protection of representative and unique marine life habitats in central California waters. **Goal 6** aims to ensure that MPAs are designed and managed, to the extent possible, as a network. **Goal 5** seeks to ensure that MPAs have clearly defined objectives, effective management, adequate enforcement, and are based on sound scientific guidelines. The first three parts of goal 5 are not evaluated scientifically and the last is why the master plan includes significant discussion of scientific guidelines.

The likelihood that any particular MPA or collection of MPAs will meet any of these five goals is based in large part on the type and magnitude of removal or mortality (collectively referred to as “take”) of living marine resources that occur within the MPAs. Three forms of take include (1) direct removal of a species from an MPA, (2) unintended incidental removal of a species in the process of targeting another species (referred to as “bycatch”), and (3) perturbation of the ecosystem in such a way that it leads to increased mortality of a species (e.g., alteration of habitat that leads to reduced refuge from predators). Take is not limited to fishing activities. For example, coastal power generating stations impinge fishes and invertebrates and entrain their larvae in the process of drawing ocean water for cooling systems. Likewise, many minor seawater intakes and sewage outfalls occur along the coast. The impacts of seawater intakes and sewage outfalls can be diffuse in nature, and can affect ecosystems both locally and regionally.

For the analysis of proposed MPA packages within the central coast region, pollutant sources and entrainment/impingement from coastal power plants, both of which may influence proposed MPAs, were not considered. This was largely a result of limited time and resources rather than a known lack of potential impact. It is recommended that the potential impact of water quality on MPAs is an important element which deserves further consideration. It is recommended that the science team work with the scientific staff of the State Water Resources Control Board and the Central Coast Regional Water Quality Control Board to more fully evaluate potential water quality impacts if requested to do so by the Blue Ribbon Task Force.

Additionally, commercial kelp harvest can reduce habitat availability and may directly and indirectly increase mortality of juvenile fishes. Thus, the level of protection and conservation value afforded by any particular MPA depends very much on the type and magnitude of fishing and other human activities that will be allowed within the marine protected areas.

State marine reserves (SMRs) provide the *greatest level of protection* to species and to ecosystems by allowing no take of any kind (with the exception of scientific take for research, restoration, or monitoring). The high level of protection created by an SMR is based on the assumption that no other appreciable level of take or alteration of the ecosystem is allowed (e.g., sewage discharge, seawater pumping, kelp harvest). In particular, SMRs provide the greatest likelihood of achieving MPA goals 1, 2, and 4.

All other MPA designations (SMCA and SMP) allow some level of extraction of one or more species. The indirect effects of this extraction are poorly understood, both with regard to how other species in the ecosystem are affected (e.g., predators, prey, competitors), as well as incidental take of other species (i.e., bycatch). Because of this uncertainty, SMRs can provide managers with a greater certainty in meeting the objectives of ecosystem-wide protection (Goal 1) and provide them with comparisons to other types of MPAs to better understand the onsequences of the direct and indirect effects of extraction allowed in those MPAs.

State marine parks (SMPs) are designed to provide recreational opportunities and therefore can allow some or all types of recreational take of a wide variety of fish and invertebrate species by various means (e.g., hook and line, spear fishing). Because of the variety of species that potentially can be taken and the potential magnitude of recreational fishing pressure, *SMPs that allow recreational fishing provide low protection and conservation value relative to other, more restrictive MPAs* (e.g., SMRs and some SMCAs). Although SMPs have lower value for achieving MLPA goals 1 and 2, they may assist in achieving other MLPA goals.

State marine conservation areas (SMCAs) potentially have the most variable levels of protection and conservation of the three MPA designations because they allow any combination of commercial and recreational fishing, as well as other extractive activities (e.g., kelp harvest). Coastal MPAs (i.e. MPAs within state waters) are most effective at protecting species with limited range of movement and close associations to seafloor habitats. Less protection is afforded to more wide-ranging, transient species like salmon and other pelagic finfish. This may lead to proposals of SMCAs that prohibit take of bottom-dwelling species, while allowing the take of pelagic finfish. However, fishing for some pelagic finfish, like salmon near the bottom or in relatively shallow water, increases the likelihood of taking bottom species that are targeted for protection (e.g., California halibut, lingcod, rockfishes). Rates of bycatch are particularly high in shallow water where bottom fish may move close to the surface and become susceptible to the fishing gear. In addition, for recreational salmon fishing, the practice of “mooching” has a potentially higher bycatch rate than that of trolling.

Participants at a recent national conference<sup>7</sup> on benthic-pelagic coupling considered the nature and magnitude of interactions among benthic (bottom-dwelling) and pelagic finfish, and the implications of these interactions for the design of marine protected areas. At this meeting, scientists and recreational fishing representatives agreed that bycatch is higher in water depths <50m (164 ft) and lower in deeper water. This information, along with incidental catch statistics provided by CDFG, formed the basis of categorization of SMCAs into three relative levels of protection of bottom-dwelling species and their habitats.

**SMCA High Protection** – These SMCAs protect benthic communities, both directly and indirectly, and allow only the take of pelagic finfish. Proposed SMCAs that prohibit take of all species except salmon and other pelagic finfish in water depth greater than 50m (164 ft) were placed in this category. SMCAs with high protection are equivalent to SMRs for protecting many, but not all, species and habitats. However, our understanding of the interactions among pelagic finfish and the benthic community is incomplete. Moreover, salmon fishing in deep water (>50m) can be conducted near the bottom, resulting in bycatch of benthic species.

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<sup>7</sup> Benthic-pelagic linkages in MPA design: a workshop to explore the application of science to vertical zoning approaches. November 2005. Sponsored by NOAA National Marine Protected Area Center, Science Institute, Monterey, CA.

Therefore these SMCAs do not have as high protection and conservation value as no-take SMRs, and are less likely to achieve MLPA goals 1,2, and 4. Moreover, SMRs are needed to evaluate the effects of SMCAs that allow the take of pelagic finfish.

**SMCA Moderate Protection** – These SMCAs protect the majority of benthic species and their habitats while allowing for the take of pelagic finfish, selected benthic fishes and invertebrates, and giant kelp (hand harvested only; see kelp harvesting section below). It is recommended that proposed SMCAs in central California that prohibit take of all species except pelagic finfish, squid, jacksmelt, butterfish, crab, spot prawn, and giant kelp should be placed in this category (a modified list of species may be appropriate in other parts of the state). These MPAs are considered to provide relatively lower protection than SMRs and SMCAs (high) primarily because they allow the take of species (crab, spot prawn and, to a lesser extent, squid) that have direct interaction, as predator, prey or habitat of those species targeted for protection. Thus, removal of these species can potentially affect the overall ecosystem (Goal 1) as well as particular species targeted for protection that feed on or otherwise interact with these species (Goal 2). In addition, take of crabs and spot prawns that live on the seafloor increases the likelihood of bycatch of those bottom-dwelling species that may be targeted for protection (i.e. rockfishes).

Although bycatch of bottom-dwelling species in market squid landings is considered minimal, the presence of bycatch has been documented through the Department's port sampling program. The port sampling program records bycatch (i.e., presence or absence evaluations), but actual amounts of bycatch have not been quantified to date. During 2004, bycatch was present in about forty-nine percent of the observed squid landings in central California, but species that constituted bycatch were primarily pelagic finfish. Benthic species targeted for protection by MPAs comprised a very small component of the squid fishery (CDFG<sup>8</sup>). Spawning squid occur near the bottom when attaching their egg masses directly onto sand sediment. Occurrence of squid as bycatch in bottom trawls also indicates their presence on or near the bottom and their co-occurrence with benthic species. Landing receipts from the commercial butterfish and jacksmelt fisheries in central California indicate some bycatch of benthic soft-bottom species such as white croaker.

The magnitude of bycatch in the commercial spot prawn trap fishery<sup>9</sup> was quantified from a CDFG observer program in 2000-2001. In central California (Point Conception to Monterey Bay), an average of about 150 pounds of bottom-dwelling fish was taken with every 1000 pounds of spot prawns. Thirty species of finfish were observed as bycatch in the spot prawn trap fishery. The top five species, in decreasing frequency of occurrence, were sablefish, rosethorn rockfish, greenblotched rockfish group (includes greenblotched, greenspotted, and pink rockfish), spotted cusk eel, and filetail catshark, comprising 78% of all fishes in the catch (by weight). Observed bycatch included seventeen species of rockfishes. Sea stars constituted the vast majority of invertebrates taken as bycatch. Other invertebrates included red rock crab, a large sea slug, galatheid crab, urchin, octopus, box crab, hermit crab, decorator crab, brittle star, feather star, and sea cucumber. Most invertebrates and many fish species, other than rockfishes, could be returned to the water alive.

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<sup>8</sup> California Dept. Fish and Game, P. Reilly, personal communication)

<sup>9</sup> Reilly, P.N. and J. Geibel. 2002. Results of California Department of Fish and Game Spot Prawn Trawl and Trap Fisheries Bycatch Observer Program 2000-2001. Report prepared for the California Fish and Game Commission (July 2002).



Bycatch associated with the Dungeness crab trap fishery has not been documented. Although some fishes associated with sand sediments are likely caught in this fishery, other crabs (mostly rock crab) are the only species reported in Dungeness crab landings<sup>10</sup>.

**SMCA Low Protection** – These SMCAs protect some benthic species and their habitats. These proposed SMCAs allow various forms of commercial and recreational fishing and kelp harvesting. Both the directed take and potential bycatch from those fisheries will greatly limit the conservation value of these MPAs relative to SMRs and SMCAs of high and moderate protection. Also, mechanical harvest of giant kelp and the harvest of bull kelp by any method result in both direct and indirect take of many invertebrate and fish species (see kelp harvesting section below). As such, these SMCAs are least likely to assist in achieving MLPA goals 1, 2, and 4.

**Kelp harvesting** – Potential impacts of kelp harvesting depend on the species of kelp, the method of harvest (mechanical or hand collection), and the volume of plant material removed. For both methods, take is constrained by regulations to the upper 1.2 m (4 feet) of the forest canopy formed at the surface of the ocean. Harvest of kelp forests is targeted primarily at the giant kelp, *Macrocystis pyrifera*, and secondarily the bull kelp, *Nereocystis luetkeana*. Importantly, giant kelp is a perennial (individual plants can live multiple years), and reproduction and new growth occur at the bottom of the plant. In contrast, bull kelp is an annual (individuals live only one year), and reproduction and new growth occur at the top of the plant. In addition the gas-filled bladder responsible for keeping the bull kelp erect is located at the surface. Therefore, kelp harvesting, regardless of method, has a greater negative impact on bull kelp than on giant kelp.

Assessments of the impact of harvest (both mechanical and hand) on giant kelp suggest minimal impact to the kelp plants themselves because the plants are not removed entirely and can re-grow rapidly to replace the removed canopy. Moreover, the reproductive portion of the plant is left intact at the bottom of the plant. However, harvest near the end of the summer may result in loss of the canopy for the remainder of the growing season. Whereas the amount of harvested bull kelp is much less than that of giant kelp, no impact assessment of harvesting has been conducted for bull kelp in California. However, negative impact to individuals and populations of bull kelp is likely to be much greater than giant kelp because the reproductive and growth capacity of the plants is terminated with harvest.

Of additional, and perhaps greater, concern with the harvesting of kelp is the (1) loss of habitat provided by the forest canopy for other species, (2) loss of production of plant material that is fed on by numerous grazers and detritivores in kelp forests and other habitats where drift kelp contributes to local productivity (e.g., heads of submarine canyons and sandy beaches), and (3) take (i.e. bycatch) of other species closely associated with the canopy habitat. The two harvesting methods differ markedly with respect to these three impacts. Mechanical kelp harvest is conducted by large, specially designed vessels that remove large volumes of the forest canopy and kill many associated species of fishes and invertebrates (including many species of juvenile rockfishes). Loss of habitat and food provided by kelp canopies translates to changes in growth, survival, and reproduction of those species associated with the canopy.

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<sup>10</sup> California Dept. Fish and Game, P. Reilly, personal communication).

The coastwide impact of this mortality on juvenile rockfishes has not been assessed. However, the impact to an individual kelp forest within a proposed MPA is likely to be substantial, with the loss of large numbers (1,000's) of juveniles. Because of the impacts of mechanical kelp harvest on the well-understood role of kelp to the structure, function, and services provided by kelps to shallow reef ecosystems (Goal 1), and on many species targeted for protection (Goal 2), SMCAs that allow mechanical harvest of kelp, even if no other extractive activities are permitted, should be *considered as having low protection and conservation value*.

Impacts of hand harvest of kelp in support of the abalone mariculture industry have received less attention, in large part because of the presumed lesser impact of this method compared to mechanical harvest. The reduced impact is based in part on the lower volume of plant material removed and the likelihood that juvenile fishes are less likely to be removed with the canopy. However, experiments by CDFG in 1977 indicated that kelp canopy removal might increase the likelihood that young-of-the-year rockfishes are consumed by opportunistic, predatory fishes such as juvenile bocaccio<sup>11</sup>. Repeated collection of the kelp canopy from the same area likely increases local-scale impacts on habitat and food production. Because the impacts of hand harvest on the well-understood role of kelp to the structure, function and services provided by kelps to shallow reef ecosystems (Goal 1), and on many species targeted for protection by MPAs (Goal 2) are less than the impacts from mechanical harvest, SMCAs that allow hand harvest of kelp should be *considered as having moderate protection and conservation value*.

### ***Setting Goals and Objectives for MPAs***

Whether MPAs within a region are reserves, parks, or conservation areas, or some combination of the above, the MLPA specifies that all MPAs have certain features. First, the MLPA requires that the Program and each MPA in the preferred alternative have specific identified objectives [FGC subsections 2853(c)(2) and 2857(c)(1)]. FGC subsection 2857(c)(1) states: “[I]ndividual MPAs may serve varied primary purposes while collectively achieving the overall goals and guidelines of this chapter.” The MLPA provides some options for what these objectives are. At FGC subsection 2857(b), the MLPA states that the preferred alternative may include MPAs that will achieve either or both of the following objectives:

- (1) Protection of habitat by prohibiting potentially damaging fishing practices or other activities that upset the natural ecological functions of the area.
- (2) Enhancement of a particular species or group of species, by prohibiting or restricting fishing for that species or group within the MPA boundary.

It is important to note that it is potentially damaging fishing practices, not fishing per se, that is addressed in the first objective, and that both the first and second objectives may be achieved outside of the MPLA itself, as a result of other regulatory processes. The California Ocean Protection Act provides a framework for identifying opportunities to meet the objectives of the MLPA through the actions of other state agencies.

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<sup>11</sup> Houk, J.L. and K. McCleneghan. 1993. Effects of kelp canopy removal on young-of-the-year rockfish abundance, using two census methods. California Dept. Fish and Game, Administrative Report No. 93-5. 29 p

Setting goals and objectives for a region and for individual MPAs within a region will be a critical step in developing meaningful alternatives for a statewide MPA network and assembling a recommended network of MPAs, and in the design of monitoring and evaluation. Assembling and evaluating available information on the biological, oceanographic, socioeconomic and governance features of a region, including existing MPAs, and other closures implemented through fishery management regulations, and also including non-fishing impacts, should precede setting regional goals and objectives. Similarly, setting regional goals and objectives should precede setting goals and objectives for individual MPAs as well as designing boundaries and management measures for individual MPAs. Importantly, the process of establishing regional goals and objectives must include stakeholder involvement in the analysis and decision-making process.

Once set, goals and objectives will influence crucial design decisions regarding size, location, and boundaries. For instance, a marine reserve whose primary goal is protection of biological diversity may well have a different configuration than a marine reserve whose goal is enhancement of depleted fisheries (Nowlis and Friedlander 2004).

There are a variety of techniques for setting goals and objectives. No one technique is likely to suit the diverse situations in all regions. Deciding upon a process for setting goals and objectives should be an early focus for regional discussions. In fashioning goals, the following characteristics should be kept in mind (Pomeroy et al. 2004).

A goal is a broad statement of intent that is:

- Brief and clearly defines the desired long-term vision and/or condition that will result from effective management of the MPA;
- Typically phrased as a broad mission statement; and
- Simple to understand and communicate.

An objective is a more specific measurable statement of what must be accomplished to attain a goal. Usually, attaining a goal requires accomplishing two or more objectives. Useful objectives have the following features:

- Specific and easily understood;
- Written in terms of what will be accomplished, not how to go about it;
- Realistically achievable;
- Defined within a limited time period; and
- Can be measured and validated.

In developing regional goals and objectives, attention should be paid to other complementary programs. For instance, like the MLPA, the Marine Life Management Act (MLMA) takes an ecosystem-based approach to management. The Nearshore Fishery Management Plan (NFMP) required by the MLMA identified MPAs as an important tool in achieving its goals and objectives. Similarly, the Abalone Recovery and Management Plan (ARMP) recommends the use of MPAs as additional protection to assist with the recovery of abalone populations and help support populations in fished areas. While the NFMP and ARMP defer to the MLPA process in designing and establishing networks of MPAs, the plans also identify key features of

MPA networks that would contribute to the goals and objectives of the NFMP, MLMA, and ARMP. Other fishery management plans should be reviewed for similar linkages. The features that MPAs should include in order to fulfill the goals of the NFMP are (from NFMP, Section 1, and Chapter 3):

- Restrict take in any MPA [intended to meet the NFMP goals] so that the directed fishing or significant bycatch of the 19 NFMP species is prohibited
- Include some areas that have been productive fishing grounds for the 19 NFMP species in the past but are no longer heavily used by the fishery
- Include some areas known to enhance distribution or retain larvae of NFMP species
- Consist of an area large enough to address biological characteristics such as movement patterns and home range. There is an expectation that some portion of NFMP stocks will spend the majority of their life cycle within the boundaries of the MPA
- Consist of areas that replicate various habitat types within each region including areas that exhibit representative productivity

The features that MPAs should include in order to fulfill the goals of the ARMP include the following (from ARMP, Section 7.1.1.3). The ARMP recommends that at least four of the following criteria should be met:

- Suitable rocky habitat containing abundant kelp and/or foliose algae
- Presence of sufficient populations to facilitate reproduction. The reproductive biology of abalone suggests that fertilization success is reliant on close proximity, thus high densities of breeding animals could promote reproduction.
- Suitable nursery areas. Nursery grounds have been identified for juvenile abalone: crustose coralline rock habitats in shallow waters which include microhabitats of moveable rock, rock crevices, urchin spine canopy, and kelp holdfasts. Protection of areas with this cryptic habitat may promote juvenile growth and survival until emergence at 50-100 mm in shell diameter. Areas where invasive surveys find high densities of small abalone (less than 50 mm) can be classified as potential nursery areas.
- Oceanographic regimes. The protected lee of major headlands may act as collection points for water and larvae. These areas (for example, the northwest portion of Drakes Bay) may promote the settlement of planktonic larvae, and act as natural nurseries (Ebert *et. al.* 1988).
- Size. Existing MPAs do not provide enough area for large numbers of abalone, nor are they ideal for research regarding population dynamics.
- Accessibility. MPAs need to be accessible to researchers, enforcement personnel, and others with a legitimate interest in resource protection.

Once developed, regional goals and objectives can be matched with the goals of the different types of MPAs, as defined by the Marine Managed Areas Improvement Act (MMAIA) at PRC Section 36700 and in the MLPA. The MMAIA defines the goals for the three types of MPAs as shown in Table 2.

Table 2: Comparison of potential marine protected area goals.

Purpose	State Marine Reserve	State Marine Park	State Marine Conservation Area
Protect or restore rare, threatened, or endangered native plants, animals, or habitats in marine areas.	X		X
Protect or restore outstanding, representative, or imperiled marine species, communities, habitats, and ecosystems.	X	X	X
Protect or restore diverse marine gene pools.	X		X
Contribute to the understanding and management of marine resources and ecosystems by providing the opportunity for scientific research in outstanding, representative, or imperiled marine habitats or ecosystems.	X	X	X
Provide opportunities for spiritual, scientific, educational, and recreational opportunities		X	
Preserve cultural objects of historical, archaeological, and scientific interest in marine areas.		X	
Preserve outstanding or unique geological features.		X	X
Provide for sustainable living marine resource harvest.			X

Although the MLPA does not identify specific goals and objectives for marine parks and marine conservation areas, it does identify possible functions, which may be considered as goals, for marine reserves. At FGC subsection 2851(f), the MLPA says that marine reserves:

- protect habitat and ecosystems,
- conserve biological diversity,
- provide a sanctuary for fish and other sea life,
- enhance recreational and educational opportunities,
- provide a reference point against which scientists can measure changes elsewhere in the marine environment, and
- may help rebuild depleted fisheries.

Some or all of these functions may apply to any particular marine park or marine conservation area. For example, a conservation area which allows fishing for salmon and pelagic species could address bullets 1-3 and 5-6 by protecting all benthic species. A marine park could address bullet 4 as well as bullet 5.

As mentioned above, the MLPA recognizes that individual MPAs may have several goals and objectives, such as protection of biological diversity and enhancement of recreational opportunities. In these instances, special care should be taken in designing management measures, such as restrictions as well as data collection and monitoring, which will maximize the different objectives and quantify whether different objectives are being met.

### ***Enforcement and Public Awareness Considerations in Setting Boundaries***

Regardless of the amount of enforcement funding, personnel, or equipment available, the enforceability and public acceptance and understanding of marine protected areas will be enhanced if a number of criteria are considered during design and siting. While the complexities of the California coastline and locations and distributions of protected habitats

and resources make using the same criteria at each location difficult, an effort should be made to include as many of these considerations as possible.

Marine protected area boundaries should be well-marked where possible, recognizable, measurable, and enforceable. Selecting known, easily recognizable landmarks or shoreline features, where possible, as starting points for marine protected area boundaries will provide a common, easily referenced understanding of those boundaries. In general, marine protected area boundaries should be straight lines that follow whole number north-south longitude and east-west latitude coordinates wherever possible. Likewise, any offshore corners or boundary lines should be located at easily determined coordinates. This is especially true if installation and maintenance of boundary marker buoys is not cost effective or feasible. Using depth contours or distances from shore as boundary designations should be avoided, if possible, due to ambiguities in determining exact depths and distances. However, in some cases, depth boundaries may be not only unavoidable but desirable. Many of California's existing MPAs in ocean waters use depth as the offshore boundary. This is a practical concession based on the use by divers who possess depth gauges but no other navigational aids. In the case of a proposed intertidal MPA, for example, depth would be the only practical alternative for an offshore boundary.

There are benefits and disadvantages to siting marine protected areas in locations that are accessible and/or observable, either from the shore or the water. On one hand they can increase the likelihood that potential illegal activities will be observed and reported, thereby discouraging such activities because they might be observed and increase public awareness of the MPA.

Conversely, MPAs sited in areas that are very easily accessed will naturally have higher potential for illegal activities to occur. Additionally, these areas will have the highest level of conflict with existing uses. Siting MPAs in areas close to harbors may raise issues of safety and convenience by requiring extractive users to travel farther to areas open to fishing could be problematic. Siting must be balanced between the ease of enforcement and monitoring and the potential for infractions to occur. If enforceable alternative areas are available farther from easy access points, they should be considered.

Siting marine protected areas within, or near, locations under special management (national marine sanctuaries and parks, state and local parks and beaches, research facilities, museums and aquaria, etc) may provide an added layer of enforcement, observation and public awareness. This is especially true if there are shore-side facilities and personnel based at the site.

### ***Information Supporting the Design of MPAs***

Throughout the development of alternative proposals for MPAs, an emphasis must be placed upon using the best readily available science, as required at FGC subsection 2855(a). The MLPA does not require complete or comprehensive science, but rather the level of science that is practicable.

Baseline data needs for MPAs should be drafted for inclusion in the regional profile and MPA management plan described elsewhere in this document. Examples of such needs are:

- Status of recreational, commercial, and other marine resources in the region;
- Status of species in need of restoration;
- Analysis of consumptive and non-consumptive activities affecting living marine resources in the region, including commercial and recreational fishing, diving, point and non-point discharges, among others;
- Analysis of existing management and regulations;
- Geographical patterns of extractive and non-extractive uses;
- Economic contribution of ocean-dependent activities to local and regional economies.

This process should also draw upon the knowledge, values, and expertise of local communities and other interested parties. At FGC subsection 2855(c)(1)-(2), the MLPA specifically requires that local communities and interested parties be consulted regarding:

- (1) Practical information on the marine environment and the relevant history of fishing and other resources use, areas where fishing is currently prohibited, and water pollution in the state's coastal waters.
- (2) Socioeconomic and environmental impacts of various alternatives.

Understanding the distribution, magnitude, and spatial extent of economic activities and values is important in the design of marine protected areas. Marine protection can both positively and negatively impact the level and sustainability of economic values, taxes and employment. Within each region a varying level of data exist for determining these values. Additionally, stakeholder groups in each region will help provide informal data on the value of resources in their area. More information on social science tools and methods can be found in Appendix E. The regional MPA process should make every effort to assemble socioeconomic information early and to apply it in the design and evaluation of MPAs.

### ***Other Programs and Activities Other Than Fishing***

Regional profiles and profiles of potential MPAs should describe current and anticipated human activities that may affect representative habitats and focal species. Water quality and marine habitats, especially in estuarine areas, may be degraded by any of a wide range of activities (Sheehan and Tasto 2001). For instance, water quality may be undermined by point source discharges from pulp mills, sewage treatment plants, manufacturing facilities, as well as by nonpoint source discharges from agriculture, urban areas, forestry, marinas and boating, mine drainage, on-site sewage systems, and by modification of river flows. Water quality and habitats may be directly affected by dredging and the disposal of dredge spoil, and by catastrophic spills of oil or other substances.

A profile should discuss whether any such non-fishing activities are significantly affecting wildlife or habitats of concern in a potential MPA site. Where the effects of any such activities present a clear threat to resources of concern, a profile should identify current efforts to mitigate those threats. Federal, state, county, and local government agencies carry out a diverse array of programs to manage such activities (Sheehan and Tasto 2001). The Governor's ocean action plan includes a useful survey of such programs (CRA and CEPA 2004). If warranted, a proposal for an MPA may include recommendations to appropriate agencies for reducing impacts of activities that are likely to prevent an MPA from achieving its

goals and objectives. Generally, such recommendations should also be referred to California Ocean Protection Council since the California Ocean Protection Act of 2004 created that body to promote coordination of ocean protection efforts across agencies. The council is ideally positioned to insure that MPAs established under the MLPA benefit from the programs and capabilities of agencies with responsibilities beyond those of the Department.

One significant aspect of the MLPA is its intent to comprehensively identify:

- areas in the ocean uniquely worthy of being reserved for their specific or intrinsic value,
- areas that need the additional protections and attention that may come with being designated as an MPA,
- habitats and species that should be protected within MPAs in each region of the state, and
- areas of the ocean that should be reserved for specific uses.

The MLPA depicts the legislature's intent to make California's existing array of MPAs function as a network. It focuses on sustaining healthy marine ecosystems for their long-term values.

One purpose of the council established by the California Ocean Protection Act of 2004 (COPA) is to coordinate the activities of state agencies related to the protection and conservation of the coastal waters and ocean ecosystems to improve effectiveness of all these efforts within limited resources. COPA and the Council may serve as the vehicle for addressing non-fishing impacts that are not under the regulatory authority of the Commission.

Efforts are being undertaken by many state and federal agencies that contribute to and support the overall goals of the MLPA. These efforts include the following:

- the Department's work to implement the Marine Life Management Act with its broader ecosystem considerations in fishery management;
- the State Water Resources Control Board recent updates to its California Ocean Plan to ensure that it establishes appropriate water quality standards and lays out a workable implementation plan;
- the work of the California Coastal Commission in monitoring local coastal programs, establishing a Critical Coastal Areas Program, permitting coastal development, and ensuring coastal zone access;
- the Resource Agency and California Environmental Protection Agency in their agreement to strengthen an MOU regarding watershed planning to give renewed support to collaborative efforts to ensure land-based activities avoid harming the marine environment in general, and bays and estuaries in particular;
- the National Marine Sanctuary Program's sponsorship of research and community discussions regarding special marine protected areas in the Monterey Bay National Marine Sanctuary.

Likewise, there are numerous similar efforts being undertaken by federal agencies including the Water Quality Protection Program of the Monterey Bay National Marine Sanctuary; the Army Corps of Engineers' Coastal Sediment Management Master Plan; and the continuing efforts of NOAA Fisheries to confront ocean impacts derived from upstream pollution, sand and gravel mining, over-drafting water rights, and invasive species.



While not all of these programs will have a significant effect on regional implementation of the MLPA and the designation of MPAs, coordination of the regional planning efforts will help identify ways that various efforts can be integrated and made supplementary to each other to avoid overlap and conflict. Identifying goals for individual MPAs and a network of MPAs in the context of the goals and objectives of these other agencies and programs will help ensure consistency. Management, research, and monitoring plans for MPAs should also be coordinated with these other agencies and programs to increase the likelihood that MPAs will successfully meet the MLPA goals with the least cost and disruption to the public benefits derived from the ocean.